RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	58,054	68,329	62,012	66,607	70,453	74,783	71,197	72,225	Continuing	Continuing
3012	Advanced Propulsion Technology	1,683	1,941	0	0	0	0	0	0	0	0
3048	Fuels and Lubrication	10,629	11,569	8,415	9,036	9,392	14,181	14,629	15,037	Continuing	Continuing
3066	Turbine Engine Technology	31,682	36,078	41,421	42,055	39,867	36,710	32,179	32,396	Continuing	Continuing
3145	Aerospace Power Technology	14,060	18,741	12,176	15,516	21,194	23,892	24,389	24,792	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: As of FY 2000, all high-speed propulsion efforts under Project 3012, Advanced Propulsion Technology, are terminated. The decrease in Project 3048, Fuels and Lubrication, beginning in FY 2000 reflects deemphasis on high thermal stability fuels and engine technologies. The decrease in Project 3066, Turbine Engine Technology, beginning in FY 2002 reflects deemphasis on turbine engine technologies. The increase in Project 3145, Aerospace Power Technology, beginning in FY 2003 reflects increased emphasis on power components for space applications.

(U) A. Mission Description: This Applied Research program develops airbreathing propulsion and aerospace power technologies. The prime areas of focus are turbine engines, dual-mode ramjets, combined cycle engines, fuels, lubricants, and aerospace power technologies. Technology advances in turbine engine propulsion and lubrication systems are part of the Integrated High Performance Turbine Engine Technology (IHPTET) program and will increase engine performance, increase reliability, reduce specific fuel consumption, and lower cost of ownership. Dual-mode ramjet and combined cycle engines will increase weapon lethality and effectiveness against time-critical targets via high-speed propulsion systems. Fuels efforts will reduce system cost, maintenance, and the usage of hazardous cleaning materials while increasing aircraft performance and life through development of thermally stable and high heat sink fuels. High heat sink fuels from coal-derived resources will be investigated. Power system technologies are focused to eliminate troublesome, centralized hydraulic systems by replacement with highly reliable electric systems. Power conditioning, thermal management, and power source improvements will significantly enhance reliability, reduce weight, and lower life cycle costs.

(U) B. Budget Activity Justification: This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion

(U) C. Program Change Summary ($ in Thousands):

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	57,261	69,061	70,539	73,303	Cont
(U) Appropriated Value	60,577	69,561			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-2,389	-1,232			
b. SBIR	-964				
c. Omnibus/Other Above Threshold Reprogrammings	-756				
d. Below Threshold Reprogrammings	1,586				
(U) Adjustments to Budget Year Since FY 1999 PB			-8,527	-6,696	
(U) Current Budget Submit/FY 2000 PB	58,054	68,329	62,012	66,607	Cont

(U) (U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program. As of FY 2000, all high-speed propulsion efforts under Project 3012, Advanced Propulsion Technology, are terminated.

FY 1999: $1,326 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT: 3012

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3012 Advanced Propulsion Technology	1,683	1,941	0	0	0	0	0	0	0	0

(U) A. Mission Description: Establishes the technology base for advanced propulsion concepts including integral rocket ramjets for missile propulsion providing increased average velocity and lethality along with combined/advanced-cycle engines and hydrocarbon fueled dual-mode combustion ramjets for high-speed vehicles to support future missions such as rapid strike against time-critical targets. Note: This project is terminated in FY 2000.

(U) FY 1998 ($ in Thousands):

- (U) $632 Investigated unique concepts for combining advanced propulsion cycles which provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.
- (U) $343 Investigated, developed, and exploited Russian hypersonic technology. This effort supports technology transition for next generation hypersonic missiles and air vehicles to provide greater range and increased velocity which enhance weapon effectiveness.
- (U) $708 Investigated unique pulse detonation engine concepts to provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.
- (U) $1,683 Total

(U) FY 1999 ($ in Thousands):

- (U) $712 Investigate unique concepts for combining advanced propulsion cycles which provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.
- (U) $378 Investigate, develop, and exploit Russian hypersonic technology. This effort supports technology transition for next generation hypersonic missiles and air vehicles to provide greater range and increased velocity which enhance weapon effectiveness.
- (U) $814 Investigate unique pulse detonation engine concepts to provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.
- (U) $37 Identified as a source for SBIR.
- (U) $1,941 Total

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BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion / PROJECT: 3012

(U) FY 2000: Not Applicable.

(U) FY 2001: Not Applicable.

(U) B. Project Change Summary - Description of Significant Changes: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) Program is reported to/coordinated by the Joint Army/Navy/NASA/Air Force (JANNAF) executive committee.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion	PROJECT: 3048

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3048 Fuels and Lubrication	10,629	11,569	8,415	9,036	9,392	14,181	14,629	15,037	Continuing	Continuing

(U) A. Mission Description: Develops advanced fuels, lubricants, and component technologies for use in aircraft, rockets, and missile engines. Conventional petroleum and alternate fuels are developed and evaluated for Air Force aerospace applications. Fuels and lubricants must be thermally stable, cost-effective, and operate at higher temperatures.

(U) FY 1998 ($ in Thousands):
- (U) $6,136 Developed high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures for aircraft and missile systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.
- (U) $1,793 Developed high performance, low emissions, robust combustor concepts for advanced turbine engines to reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.
- (U) $2,700 Developed lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.
- (U) $10,629 Total

(U) FY 1999 ($ in Thousands):
- (U) $4,227 Develop high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures for aircraft and missile systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.
- (U) $2,484 Develop high performance, low emissions, robust combustor concepts for advanced turbine engines to reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.
- (U) $4,633 Develop lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.
- (U) $225 Identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion
	PROJECT 3048

– (U) $11,569 Total

(U) FY 2000 ($ in Thousands):

– (U) $2,993 Develop high thermal stability hydrocarbon fuels to provide higher heat capacity, higher operating temperatures, and reduced signatures for aerospace systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.

– (U) $2,000 Develop high performance, low emissions, robust combustor concepts for advanced airbreathing engines to reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.

– (U) $3,422 Develop lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.

– (U) $8,415 Total

(U) FY 2001 ($ in Thousands):

– (U) $3,138 Develop high thermal stability hydrocarbon fuels to provide higher heat capacity, higher operating temperatures, and reduced signatures for aerospace systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.

– (U) $2,200 Develop high performance, low emissions, robust combustor concepts for advanced airbreathing engines to reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.

– (U) $3,698 Develop lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.

– (U) $9,036 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion / PROJECT: 3048

(U) B. Project Change Summary - Description of Significant Changes: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3066

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3066 Turbine Engine Technology	31,682	36,078	41,421	42,055	39,867	36,710	32,179	32,396	Continuing	Continuing

(U) A. Mission Description: Develops technology to increase propulsion system operational reliability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. Analytical and experimental efforts are conducted in fans/compressors, high temperature combustors, turbines, internal flow systems, controls, exhaust systems, and structural design. This project supports the Integrated High Performance Turbine Engine Technology (IHPTET) program.

(U) FY 1998 ($ in Thousands):

- (U) $28,632 Developed core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transport. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $3,050 Developed turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $31,682 Total

(U) FY 1999 ($ in Thousands):

- (U) $24,810 Develop core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $5,875 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $2,415 Develop components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
- (U) $2,277 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.
- (U) $701 Identified as a source for SBIR.
- (U) $36,078 Total

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BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion — PROJECT: 3066

(U) FY 2000 ($ in Thousands):

- (U) $29,386 Develop core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $6,958 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $2,861 Develop components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
- (U) $2,216 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.
- (U) $41,421 Total

(U) FY 2001 ($ in Thousands):

- (U) $29,754 Develop core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $7,045 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $2,897 Develop components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
- (U) $2,359 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.
- (U) $42,055 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion
	PROJECT: 3066

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands):

(U) Related Activities:
- (U) PE 0602102F, Materials.
- (U) PE 0603202F, Aircraft Propulsion Subsystem Integration.
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) PE 0602122N, Aircraft Technology.
- (U) PE 0603210N, Aircraft Propulsion.
- (U) PE 0603003A, Aviation Advanced Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3145

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3145 Aerospace Power Technology	14,060	18,741	12,176	15,516	21,194	23,892	24,389	24,792	Continuing	Continuing

(U) A. Mission Description: Develops technologies for aerospace power generation, conversion, and transmission systems including advanced electrical power component and subsystem technologies. Power components are developed for aircraft and flight line equipment to increase reliability, maintainability, commonality, and supportability. This project supports an initiative which uses electrical power to replace hydraulic and pneumatic power and their costly logistics support. These electrical power technologies are necessary to meet the 10-20 year long-term storage requirements of Air Force uninhabited combat aerial vehicles (UCAVs). Electrical power generation technologies developed are enabling technologies for all future military directed energy (DE) weapon systems. This project supports development of very high output power systems that are suitable for applications such as Space Based Laser. Essentially, all power electronics (conversion) technology being developed here has dual-use opportunities. Spin-off application areas include all military system conversion development from conventional to electrically-based on-board subsystems.

(U) FY 1998 ($ in Thousands):
- (U) $12,047 Developed power generation, conversion, and transmission components for aircraft systems. These components provide aircraft with a high degree of self-sufficiency, improved reliability, maintainability, and supportability, all yielding a quicker aircraft turn-around time. In addition, ground support equipment requirements will be dramatically reduced.
- (U) $1,505 Developed power sources for guidance, navigation, and control functions for missile systems, and for use in navigational aids, radios, and sensors for special operations forces. Power sources with higher power density, longer life, and increased reliability will provide missiles systems and special operations forces with greater reliability and reduced maintenance costs.
- (U) $508 Developed special purpose power components for advanced surveillance and communications systems, as well as ground power applications.
- (U) $14,060 Total

(U) FY 1999 ($ in Thousands):
- (U) $16,153 Develop power generation components for aircraft systems. These components improve aircraft self-sufficiency, reliability, maintainability, and supportability.
- (U) $1,738 Develop power source components for use in navigational aids, radios, and sensors for special operations forces. Power sources with higher power density, longer life, and increased reliability will provide special operations forces with greater reliability and reduced maintenance costs.
- (U) $487 Develop special purpose power components for advanced directed energy weapon systems, as well as ground power applications.
- (U) $363 Identified as a source for SBIR.
- (U) $18,741 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
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PROJECT 3145	

(U) FY 2000 ($ in Thousands):

- (U) $4,501 Develop power generation components for aircraft and space systems. These components improve aircraft and space systems self-sufficiency, reliability, maintainability, and supportability.
- (U) $6,275 Develop advanced power electronics and energy storage components for aircraft, space, and directed energy power systems.
- (U) $1,400 Develop power and thermal management system components to increase performance and reliability and reduce weight in space power applications.
- (U) $12,176 Total

(U) FY 2001 ($ in Thousands):

- (U) $5736 Develop power generation components for aircraft and space systems. These components improve aircraft and space systems self-sufficiency, reliability, maintainability, and supportability.
- (U) $7996 Develop advanced power electronics and energy storage components for aircraft, space, and directed energy power systems.
- (U) $1,784 Develop power and thermal management system components to increase performance and reliability and reduce weight in space power applications.
- (U) $15,516 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.